REPORT

ON

PROPOSED HYDRO ELECTRIC SCHEME AT BHATKAL.

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Accompaniments to file no 8672/36.

SIR BRUCE WHITE, WOLFE BARRY & PARTNERS,

GROSVENOR GARDENS HOUSE,

35 GROSVENOR GARDENS,

LONDON. S.W.1

NOVEMBER. 1946.

SIR BRUCE WOLFE BARRY & PARTNERS
INCORPORATING
WOLFE BERT WHITE AND PARTNERS.
& COCHRANE & PARTNERS.
CONSULTING CHARTERED CIVIL ENGINEERS
SIR BRUCE W... M.INST.C.E., M.I.MECH.E., M.I.E.E
COLIN M.C., M.INST.C.E., M.CONS.E.
J. ANE, M.C., M.INST.C.E.
J. A. M.INST. C.E., M.I.MECH.E.

Grosvenor Gardens House,
35 Grosvenor Gardens,
Westminster, S.W.1.

TELEGRAMS: - BRENTESIA, SOWEST. LONDON.
TELEPHONE: - VICTORIA 4313 AND 6436.

REPORT ON HYDRO ELECTRIC SCHEME AND WATER SUPPLY IN SHIPYARD AND TOWN AT BHATKAL SHIPYARD.

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Adjustment to costs for post war prices

SIR BRUCE W. WOLFE BARRY & PARTNERS.
INCORPORATING
WOLFE W. ROBERT WHITE & PARTNERS.
A. J. Y. COCHRANE & PARTNERS.
CONSULTING CHARTERED CIVIL ENGINEERS.
SIR BRUCE E. K.B.E., M.INST.C.E., M.I.MECH.E. M.I.E.E.
COLIN R. W. M.C., M.INST.C.E., M.CONS.E.
J. A. COCHR M.C., M.INST.C.E.
A. S. ROL

Grosvenor Gardens House,
35, Grosvenor Gardens,
Westminster, S.W.1.

TELEGRAMS: BRENTESIA, SOWEST, LONDON.
TELEPHONE: VICTORIA 4313 AND 6436.

BHATKAL SHIPYARD

REPORT ON HYDRO ELECTRIC SCHEME AND WATER SUPPLY FOR SHIPYARD AND TOWN

1. Scope of Report

This report arises out of a proposal to establish a shipyard at Bhatkal. Bhatkal is situated on the west coast at the southern boundary of the Bombay Presidency and about 365 miles south of Bombay (see the small map of India inset in the attached sketch map).

It covers an investigation into the possibilities of generating sufficient hydro electric power in the vicinity of the town to supply the requirements of the shipyard, the town and of other industry which it is expected will become established there. The provision of a suitable water supply is interlocked with this, and has been investigated in the same way.

2. Limitations affecting this report

This report and estimates have been drawn up with an inch to the mile map as the only source of information about the ground, with no geological information other than the knowledge of the general formations to be found in the Western Ghats, and with no knowledge of post war contract prices. The position with regard to information about rainfall is set out in para.4 below.

Proposals for dam sites, etc. are therefore only made subject to survey on the spot.

Estimates of the amount of work required at any dam site are made subject to the result of borings and trial pits.

Estimates of cost are given subject to correction

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by comparison with prices for which earthwork and concrete etc. are actually being undertaken. Appendix 3 shows how the estimated costs should be adjusted as soon as prices for comparable work are known.

3. Survey

A general survey of the hydro electric sites should be made as soon as possible. It is expected that an aerial survey of the larger areas would prove the most rapid and cheapest method. Some work on the ground is necessary in an aerial survey, and in addition the following work could not be satisfactorily done from the air.

(a) Levels over the town planning site.

(b) Levels along the line of hydro electric and water supply pipes.

(c) Levelling and detail survey at the dam sites.

(d) Trial pits and borings at dam and power house sites.

Rainfall gauges, and gauges to measure the flow of streams past the dam sites should be established at the earliest possible moment.

4. Alternative Schemes

Four schemes were considered in detail.

The sites of the dams are marked on the sketch map at (1), (2), (3) and (4). Those marked (2) and (4) are low head schemes and (1) and (3) high head. It was evident that of the two low head schemes that at (2) was the best, and of the two high head schemes that at (1) was the best. It has not been possible to decide on information available here whether scheme 1 or scheme 2 is the more advantageous. Full details of both are therefore given. It is observed that portions of the schemes overlap into the Madras Presidency and into the State of Mysore, as shown on the sketch map.

It should be noted that scheme 2 may be increased to double the power given, either by building a

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initially, or by raising the dam at some future date. The cost per K W for the extra power would remain the same.

5. Rainfall

There is an official rain gauge of the Meteorological Survey of India at Bhatkal. This is assumed to be situated in the town, and gives an average rainfall of 147.49 inches per annum. It is normal for the rainfall immediately in front of an immediately behind the crest of the coastal Ghats to be considerably more than that falling at a place like Bhaktal some seven or eight miles west of the crest. Calculations for both sites have been made:

(a) on the basis of 140" of rainfall over the entire area.

(b) on the basis of 250" for scheme 1 which has a small catchment immediately behind the crest, and of 200" for scheme 2 which is in a valley surrounded by hills up to 2,000 ft.

It has been assumed that only 65 per cent of the average rainfall would be available in the driest year.

6. Power required

The estimated steady requirement of the shipyard is about 900 H.P. for 10 hours, equivalent to, say, 6,700 K W hrs a day. The maximum demand for the shipyard would be 1,800 H.P. (1350 KW or at .8PF 1700 KVA).

The town, housing shipyard workers and their families, shopkeepers etc. about 20,000 in all, and presuming electric light in all quarters, would require about 3,300 K.W. hrs a day with a maximum demand of 320 K.W. (or at .8PF 400 KVA).

The total would thus be about 10,000 K.W. hrs. a day, and a maximum demand of 2,100 KVA.

7. Relative Advantages of Schemes

Assuming that the rainfall of 250" for scheme 1 is correct, the power available, see Table B Col 1(b), is 45,600 K W hrs a day, and is ample for a considerable extension of industry. Even if the rainfall should prove something less than 250", Table B Col 1(a) shows that for 140" of rainfall there would still be a reasonable margin. Scheme 1 is therefore adequate in size, whilst the last two lines of Table A show that it has an advantage both in cost per horse power installed and in cost per unit generated.

If it is considered that there may be a substantial increase in industries in this area almost immediately, Scheme 2 would provide, at slightly greater cost, a very large margin of power for expansion.

If Scheme 1 would be adequate for a period of years, but ultimately the area would be intensively developed, Scheme 2 could be built later. In this manner money would not be tied up in an expensive plant which would have to wait several years before it could earn a profit.

8. Water Supply

Table C shews the cost of incorporating a water supply scheme for the town and shipyard with either of the hydro-electric schemes, and also of an alternative separate water supply scheme

9. Summary

This report shews that excellent sites for hydro electric stations exist near to Bhatkal, and that electricity can be generated there in any quantity which could conceivably be used in the neighbourhood, and at low cost.

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It is however emphasised that the report is based on the slender data noted in para.2. All the figures in the report and annexed tables are given subject to confirmation after surveys have been made, borings taken and rainfall and stream discharge measurements made at the site.

November, 1946.

SIR BRUCE WHITE, WOLFE BARRY & PARTNERS

Appendix 'I'

BHATKAL HYDRO ELECTRIC SCHEME
TABLE 'A'
COMPARATIVE COSTS

Scheme No.	1.		2.	
	(a)	(b)	(a)	(b)
1. Preliminary Work Roads, construction camp etc.	Rs. 6,54,000	Rs. 6,81,000	Rs. 4,85,000	Rs. 4,85,000
2. Power Station	4,30,000	6,66,000	12,53,000	16,75,000
3. Power Transmission	2,58,000	2,68,000	1,20,000	1,33,000
4. Reservoir and Dam Clearing and Scarrifying.	10,000	11,000	72,000	72,000
5. Cut-off Trench	18,000	18,000	1,31,000	1,31,000
6. Bank Filling and consolidation.	80,000	1,80,000	-	-
7. Core concrete and concrete in cut-off trench.	2,64,000	4,69,000	7,19,000	7,19,000
8. Spillway.	49,000	51,000	-	-
9. Dam Masonry and concrete.	11,000	17,000	75,38,000	75,38,000
10. Take-off Tower and fittings.	11,000	13,000	17,000	17,000
11. Diversion of stream	15,000	16,000	1,00,000	1,00,000
12. Pipeline.	2,19,000	3,35,000	3,10,000	4,38,000
13. Miscellaneous. Engineering Costs, Supervision and Contingencies.	6,02,000	8,77,000	28,57,000	31,56,000
14. Survey Costs	60,000	60,000	60,000	60,000
TOTAL	26,81,000	36,62,000	1,36,60,000	1,45,20,000
Maximum horse-power	4,000	7,600	12,600	18,900
Cost per horse-power (Rs)	656	474	1,080	765
Cost per KW hour (As)	0.38	0.23	0.39	0.28

BHATKAL HYDRO ELECTRIC SCHEME
APPENDIX I - TABLE B

PRINCIPAL DIMENSIONS

Scheme No	1.		2.	
	(a)	(b)	(a)	(b)
1. Assumed mean annual rainfall	140"	250"	140"	200"
2. Area of catchment (sq miles)	1.9	1.9	80	80
3. Area of reservoir (sq miles)	0.32	0.41	7.2	7.2
4. Type of dam	Earth	Earth	Concrete (gravity)	Concrete (gravity)
5. Height of dam (feet)	60	80	160	160
6. Length of dam at crest (feet)	550	750	1,450	1,450
7. Level of crest of dam (feet above sea level)	1,970	1,990	200	200
8. Level of power house	245	245	40	40
9. Length of pipeline to power house (miles)	3	3	1/10	1/10
10. Length of transmission line (miles)	15.	15	7	7
11. Maximum horse-power available	4,000	7,600	12,600	18,900

November, 1946.

BHATKAL SHIPYARD

APPENDIX I. - TABLE C

Comparative costs of Water Supply Schemes.

(These costs do not include the distribution system in the town.)

	Incorporated with Hydro-electric Scheme 1.	Incorporated with Hydro-electric Scheme 2.	Separate Scheme
Capital Cost	Rs. 9,74,000	Rs 6,57,000	Rs7,69,000
Annual cost of running, maintenance and depreciation	1,55,000	76,000	89,000

November,1946.

APPENDIX III

Adjustment to costs for post-war prices

Earthwork

The cost of earthwork in the dam has been taken as Rs 43 per thousand cubic feet (inclusive of consolidation) for a lead of 1,500 ft. The totals shewn for Scheme 1(a) in Table A should be raised or lowered by Rs 1,860 for every rupee above or below Rs 43 per thousand cubic feet in the actual cost of earthwork.

The corresponding figure for Scheme 1(b) is Rs 4,200 for each rupee above or below the assured price.

Concrete

The cost of mass concrete has been taken as Rs 100 per 100 cubic feet. For each rupee above or below this in the actual rate, the totals in Table A should be adjusted as follows:-

Scheme 1(a)	Rs 3,000
" 1(b)	Rs 4,930
" 2(a)	Rs 83,500
" 2(b)	Rs 84,600

C A T C H M E N T A R E A Nº 2.

RESERVOIR Nº 2

M SITE Nº 2
POWER HOUSE
SITE Nº 2.

14°N — 74°35'E

RESERVOIR Nº 1.

CATCHMENT AREA
Nº 1.

DAM SITE Nº 1.

PIPELINE TO POWER
HOUSE.

MADRAS

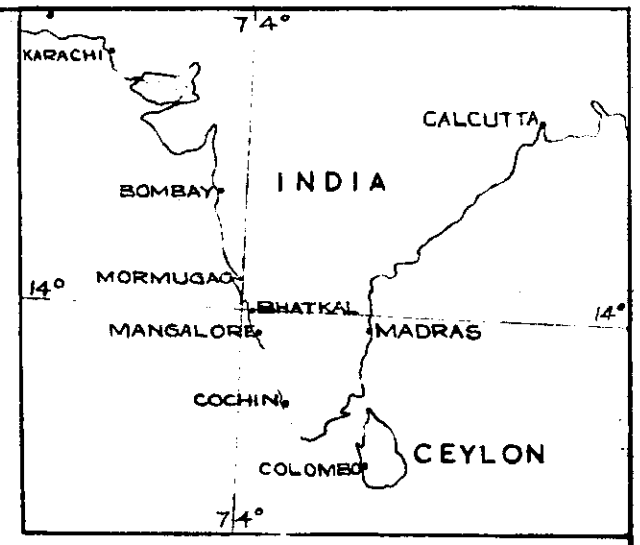
14°N.

P R E S I D E N C

O R E

S

L



KEY.

SCHEME Nº 1 COLOURED - - - - RED.

" " 2 " - - - - - GREEN

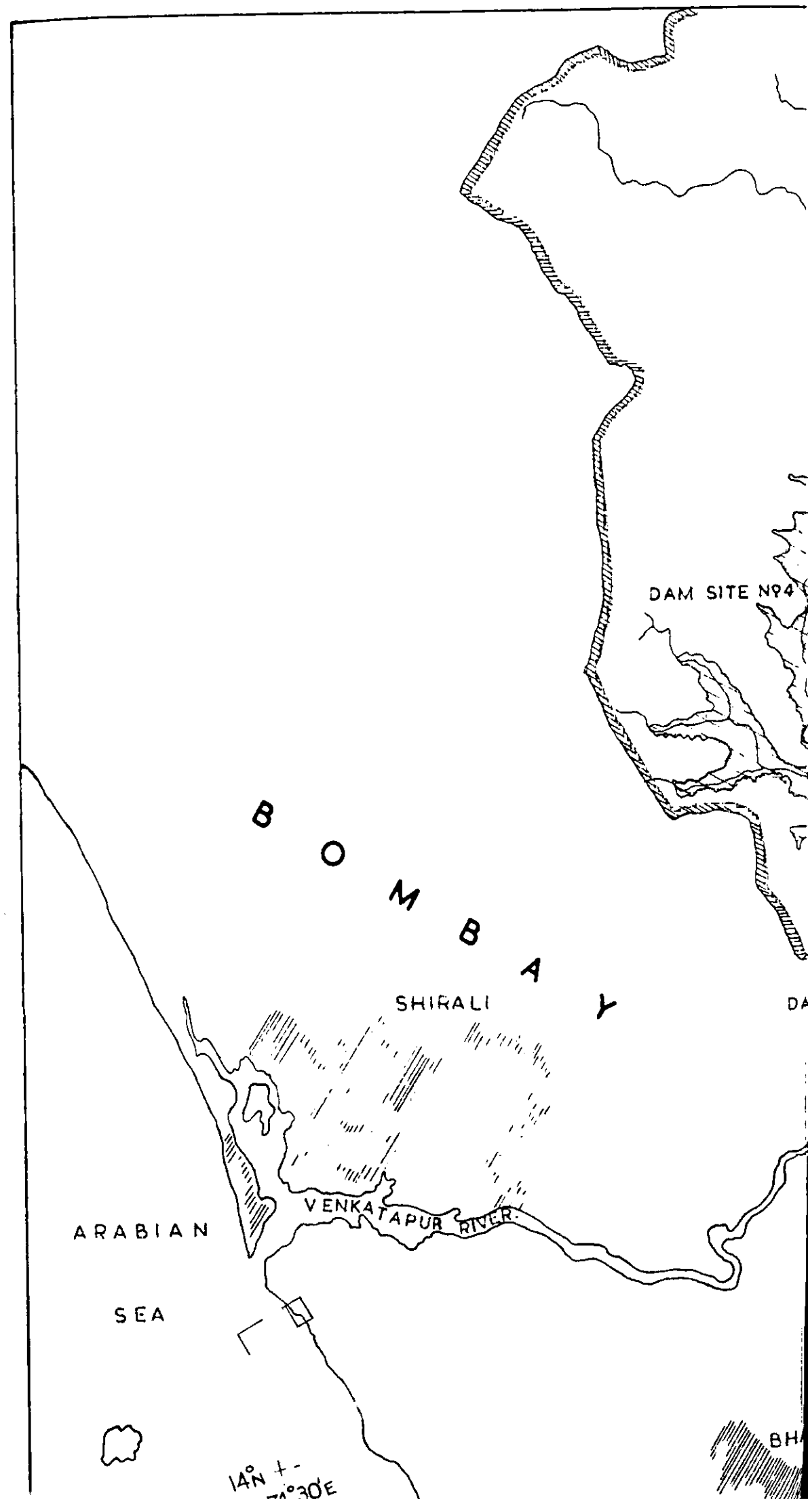
AREA COVERED BY RESERVOIRS OF
BOTH SCHEMES COLOURED - - - - - BLUE

SIR BRUCE WHITE, WOLFE BA[illegible]

[illegible] M.I.C.E., M.I.M.&C.E.

BHATKAL HYDRO ELECTRIC SCHEME.	
TITLE OF DRAWING.	SITE PLAN.
SCALE.	1 INCH = 1 MILE.

SIR BRUCE WHITE, WOLFE BARRY & PARTNERS.
DRAWING Nº 6772


DAM SITE Nº4
B O M B A Y
SHIRALI
VENKATAPUR RIVER
ARABIAN
SEA
14° +-